# bhi-ltd NEDSP1962-PCB DSP Noise Cancelling PCB Module User Manual



Contents



## bhi-ltd NEDSP1962-PCB DSP Noise Cancelling PCB Module


**NEDSP1962-PCB**The NEDSP1962-PCB is a modular solution for noise reduction. It incorporates Digital Signal Processing (DSP) technology to provide up to 40 dB of noise reduction and up to 65 dB of heterodyne tone reduction. The module features an on-board power amplifier to allow it to be easily incorporated into existing equipment, in line with the loudspeaker.

**Module Features:**

- Noise reduction up to 40 dB
- Heterodyne tone reduction up to 65 dB
- On-board power amplifier
- Designed to pass speech
- Can pass other signals such as data, music, and morse (CW) to some degree depending on filter level setting
- Designed to be driven from a High-Level signal source
- Audio Output Amplifier is ‘Class D’
- Module connections via connection pads down either side of the PCB
- Module can be securely fitted using 4 off M3 securing holes provided

**Module Connection and Mounting:**Connections to the module are made via connection pads down either side of the PCB. These pads are in 0.1 (2.54 mm) pitch connector spacings, which allows the use of standard pin headers, PCB connectors, or direct wiring. The connector positioning has been made such that the module may be ‘Plugged’ into a mother board as part of a larger system. It is recommended that the module is securely fitted using the 4 off M3 securing holes provided, making sure that the module is stood at least 3 mm off any surface underneath it.

**Module Description:**The NEDSP1962-PCB module has a block diagram and layout as shown in the figures below:

**Connector and Pin Functions:**The pin functions for the different connectors on the module are as follows:

### PL1 – Controls

| Pin | Function |
|---|---|
| 1 | Push Button 1 |
| 2 | Not Used |
| 3 | Not Used |
| 4 | Ground |

### PL2 – Function LED's

| Pin | Function |
|---|---|
| 1 | Red LED (Anode) |
| 2 | Not Used |
| 3 | Green LED (Anode) |
| 4 | Ground |

### PL7 – Remote DSP settings

| Pin | Function |
|---|---|
| 1 | DSP Off |
| 2 | DSP Level Bit 0 |
| 3 | DSP Level Bit 1 |
| 4 | DSP Level Bit 2 |
| 5 | Ground |

### PL8 – Audio Input and Output

| Pin | Function |
|---|---|
| 1 | Input Signal |
| 2 | Signal Ground |

### PL9 – Speaker Drive

| Pin | Function |
|---|---|
| 1 | +Ve Speaker Drive |
| 2 | -Ve Speaker Drive |

## Introduction

The NEDSP1962-PCB is a modular solution for noise reduction. It incorporates Digital Signal Processing (DSP) technology to provide up to 40 dB of noise reduction and up to 65 dB of heterodyne tone reduction. The module

features an on-board power amplifier to allow it to be easily incorporated into existing equipment, in line with the loudspeaker.

**The NEDSP1962-PCB Module features**

- Fully adaptable noise cancellation up to 40dB
- Overall Gain control
- Input level overload indicator
- Virtually no distortion to speech signals
- Easy to install
- 8 levels of Noise Reduction
- Frequency Response (50 Hz to 5 kHz)
- Up to 7.5 Watts output (4Ω)
- Noise Reduction can be preset or remotely set during operation
- 10 to 18 Volts DC supply range
- Wide range of connection possibilities
- Mounting Holes
- Audio bypassed when power disconnected or the module is placed in its Off state.
- Small Size 70.6 mm x 50.1 mm

**Limitations**

This module is designed to pass speech. Other signals such as data, music and morse (CW) will pass through to some degree depending on the filter level setting, but the integrity of these signals cannot be guaranteed.
This module is designed to be driven from a High-Level signal source capable of operating into a load of 62Ω impedance.
Important Note: The Audio Output Amplifier is ‘Class D’ and therefore neither of the output wires should have any connection to ground, they should only be connected to a speaker or a fully isolated socket for headphones.

**Module connection and mounting**

Connections to the module are made via connection pads down either side of the PCB. These pads are in 0.1” (2.54 mm) pitch connector spacings, which allows the use of standard pin headers, PCB connectors or direct wiring. The connector positioning has been made such that the module may be ‘Plugged’ into a mother board as part of a larger system.
It is recommended that the module is securely fitted using the 4 off M3 securing holes provided, making sure that the module is stood at least 3 mm off any surface underneath it. See section 6 for the module physical dimensions, connector positions and fixing information.

Alternatively, the module may be mounted using the self-adhesive foam pad supplied, but all caution should be taken to ensure that none of the circuit pins make contact with any metallic parts.
It is preferable to mount the module using the 4 off M3 clearance holes at the corners. See section 6 for the hole details and physical dimensions. Alternatively, the 4 off adhesive pads can be used close to the edges on the underside of the module.

**DSP Noise cancellation**

The bhi DSP processes the incoming signal and then differentiates the speech from the noise the noise. The unwanted noise and interference is then attenuated to leave only speech.
The following diagrams are taken from actual audio signals and illustrate how the signal the signal looks before

and after processing.

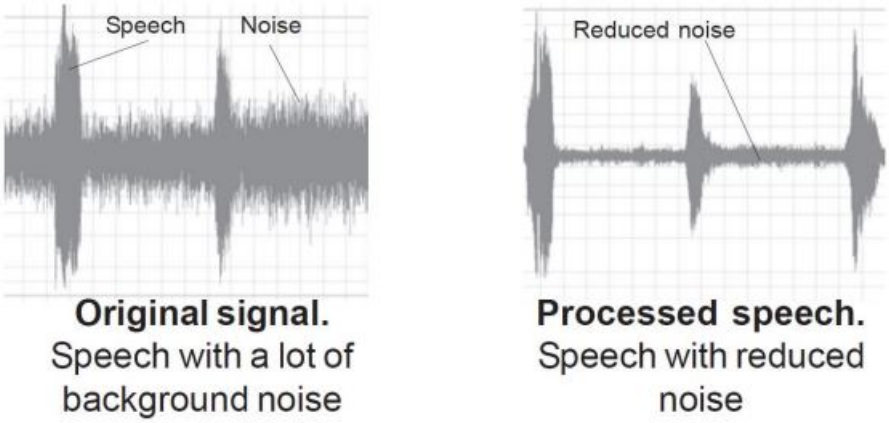



Figure 3 -Noise Reduction

## Module Description

### Block Diagram of module

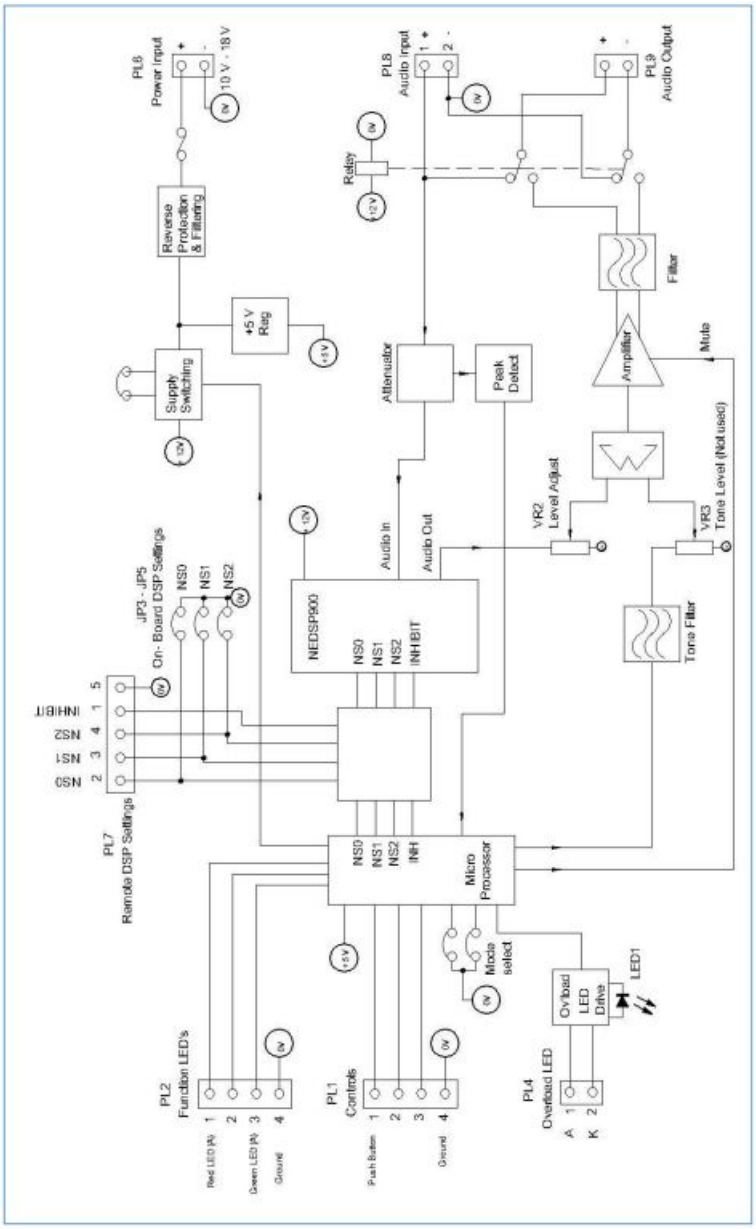
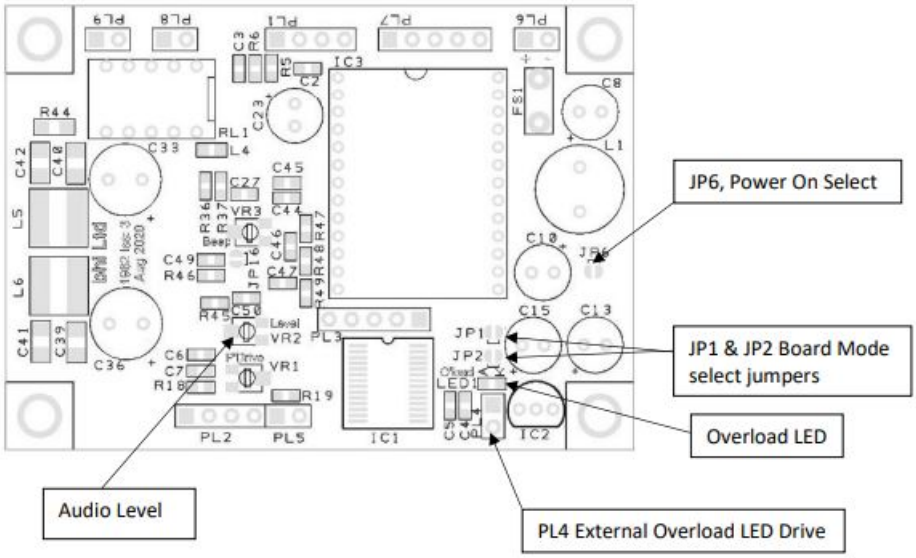



Figure 4. NEDSP1962 block diagram

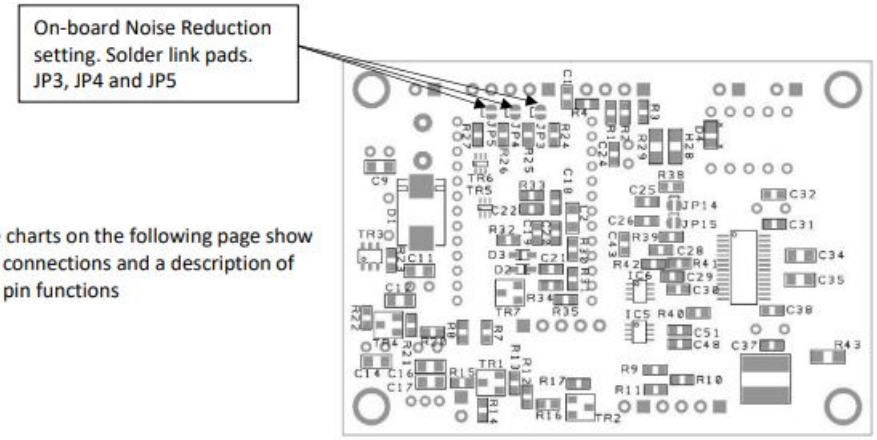
**Module Layout**
The following diagrams show the layout of the NEDSP1962 module




**Topside Pictorial**

**Figure 5. NEDSP1962 connections and controls**

**Underside Pictorial**




The charts on the following page show the connections and a description of the pin functions

**Connector and Pin Functions**

**PL1 – Controls**

| Pin | Function | Connection To | |
|---|---|---|---|
| 1 | Push Button 1 | | Power On Push Button/logic Input |
| 2 | Not Used | | Not Used |
| 3 | Not used | | Not Used |
| 4 | Ground | | Common Ground |

**PL2 – Function LED's**

| Pin | Function | Connection To | |
|---|---|---|---|
| 1 | Red LED (Anode) | On/ DSP Disabled LED | Anode |
| 2 | Not used | | Unused |
| 3 | Green LED (Anode) | ON/DSP Enabled LED | Anode |
| 4 | Ground | | Common Cathode (K) |

**PL4 – Signal Overload/Fault LED**

| Pin | Function | Connection To | |
|---|---|---|---|
| 1 | Red LED (Anode) | Anode | |
| 2 | Red LED (Cathode) | Cathode | |

**PL6 – Power Input**

| Pin | Function | Connection To | Comments |
|---|---|---|---|
| 1 | + Ve supply | | 10 Volts to 18 Volts DC |
| 2 | -Ve Supply | | |

**PL7- Remote DSP settings**

| Pin | Function | Connection To | Comments |
|---|---|---|---|
| 1 | DSP Off | | Ground to Inhibit |
| 2 | DSP Level Bit 0 | | Binary Level Set Ground to Activate |
| 3 | DSP Level Bit 1 | | Binary Level Set Ground to Activate |
| 4 | DSP Level Bit 2 | | Binary Level Set Ground to Activate |
| 5 | Ground | | |

**PL8 – Audio Input**

| Pin | Function | Connection To | Comments |
|---|---|---|---|
| 1 | Input Signal | | |
| 2 | Signal Ground | | |

**PL9 – Audio Output**

| Pin | Function | Connection To | |
|---|---|---|---|
| 1 | +Ve Speaker Drive | | Do not short to Ground |
| 2 | -Ve Speaker Drive | | Do not use as Ground |

## Connections

**NOTES**

1. Please make sure that Jumpers JP1 and JP2 are only soldered across when a specific mode is required.
2. While the Audio Input is referenced to ground, the audio output is balanced. It is therefore imperative that the Speaker (-) connection is not grounded at all.
3. When using this module with a headphone socket, place a 100 Ohm 3-Watt resistor between the Speaker (-) ground and the socket Ring, while switching the Speaker (+) through the socket Tip connections.

**LED Overload Indicator**

A LED indicator is provided on the PCB (LED1) to indicate that there is an Audio Overload or Fault condition. If this indication is not viewable, a further LED indicator may be wired to PL4, refer to connection tables above.

**LED Status Indicator**
Connection is made available for two LED's via PL2 in order to provide an indication of the DSP status. Either two independent LED's, One Red and one Green or a single LED with 3 legs, containing both Red and Green elements with a Common Cathode. (Refer to connection tables).

**Controls**
**Power ON/OFF**
There are 2 modes of module activation available dependent on the Solder jumpers fitted.

- a) To activate the module when power is applied to the board add a 'solder jumper' across JP6, located between Adjacent to L1 and C10 will ensure that the module powers up every time power is applied to the module.
- b) To toggle the module On and Off when required when power is applied is achieved by removing the 'solder jumper' across JP6 and place a 'solder jumper' across JP1. A Push Button connected to PL1, between Pins 1 and 4 (Refer to connection tables) will Toggle the power on and off. Alternatively, the same toggle action may be achieved by connecting a logic signal between PL1 Pins 1 and 4. The Logic signal should be no more than +5 Volts under normal conditions and then to toggle the power this signal should be toggled low for about 20 mS before returning high again.

At each Power On function, leave about 2 Seconds for the module to 'boot' properly. A set of ascending tones may be heard to notify you that the module is functional.

## Setting the Audio Level

- The output 'Level' control, VR2, provides adjustment of the overall gain of the module. This will be pre-set at

the factory to approximately 1, but you may feel that you want a little more gain and hence more output volume.

- To adjust the level control, make sure the Noise Reduction DSP is switched off by grounding Pins 1 and 5 of PL7. Connect an appropriate speech audio signal. This should be set to a comfortable listening audio level. With the module un-powered or in its off state, the audio is fed straight through from the source to the speaker.
- Apply power to the module and/or use the Power On button to turn the module on.
- Once the module is operating, ensure that the audio level heard from the speaker sounds very similar to how it was before the module was powered. You may adjust VR2 carefully to set the level. This may be slightly higher than that provided when the module was in the Off state. Turning the module On and Off you should hear the difference in audio levels.
- As you now adjust the level of your source audio, you should now hear the speaker volume increase/decrease commensurately. Check that when increasing the source audio level, the Overload indicator (LED1) does not illuminate on speech peaks. If the indicator illuminates at any time, this shows that the audio peaks are too high for the DSP to operate correctly which will lead to distortion.
- Once set, the output level control can be left alone allowing the audio level to be adjusted using the main equipment Volume Control. (see Overload LED).
- The module is all set up and ready to go.

#### Electrical Characteristics

### DC Charactaristics

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| Vs | Supply Voltage | | 10 | 14 | 18 | V |
| Iqs | Quiescent Current | Vs = 10 V Vs = 14 V Vs = 18 V | | 40 | | mA |
| Iqon | Quiescent current with DSP On, no l oad and no signal | Vs = 10 V Vs = 14 V Vs = 18 V | | 80<br>90<br>100 | | mA |

| Symbol | Parameter | Test Conditions | Min. | Typ. | Max. | Units |
|---|---|---|---|---|---|---|
| Po | Output Power | IO High =0.4 mA | 4.3 W | | | V |
| Vi | Input Sensitivity 8 Ω<br>Load | f = 1kHz Po = 0.5 W | | | | V |
| Vi | Input Sensitivity 8 Ω<br>Load | f = 1kHz | | | | |
| 3dB BW | DSP Off | Po =1 W<br>RL = 8 Ω | 200 | | 5000 | Hz |
| d | Distortion | f = 1kHz<br>Po = 0.2 – 5 W RL = 8Ω | | 0.3<br>0.3 | | % |
| Ri | Input<br>Resistance | | | 62 | | Ω |
| Gv | Voltage Gain | f = 1kHz | | | | |
| ɳ | Efficiency | f = 1kHz<br>Po = 0.5 W | | >80 | | % |

## Troubleshooting

A Clicking sound in a connected speaker or headset suggests a circuit fault. Check the status of LED1 and/or the Off board (Via PL4) Overload LED. If either of these are on permanently, then there may be a possible speaker fault, the wires have been shorted or that one of the speaker wires has been grounded. Check the speaker and/or wiring for faults before trying to switch the module on again. If this issue persists, then refer the problem to bhi Ltd or its distributors.

## Installation

### Installation Overview

The NEDSP1962 module is inserted into the path of noisy audio. The Level control (VR1) allows the module to be fine tuned to suit most applications.

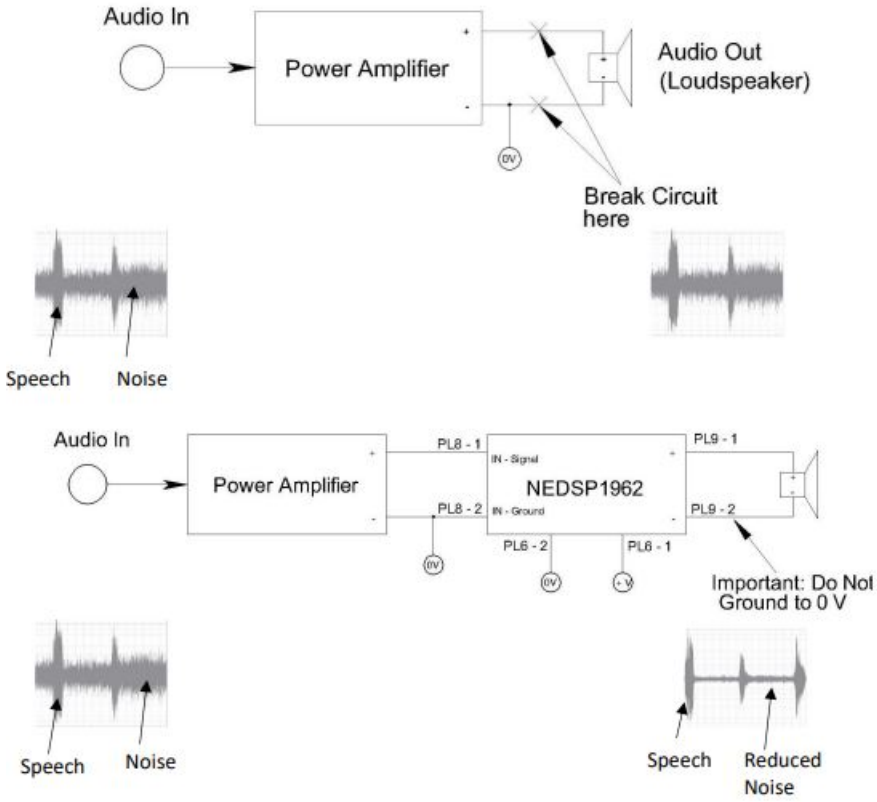



Figure 6. Basic connection diagram

The input to the module is loaded at approximately 62 Ω. When switched off, the signal is placed directly on the speaker and of course the impedance becomes whatever value the speaker is.

**Overview**
To obtain the best results from this module, it should be set up such that the output level sounds is the same whether the unit is switched On or Off. The input sensitivity has a range of 70mW to 3 Watts to provide a 8 Watt output.

Under certain conditions the DSP may create a very small amount of noise when no signal is applied. If set up correctly and without the DSP being set too high you should not be able to hear this noise when an audio signal is applied.

**Basic set up procedure**

- Ensure that the NEDSP1962 module is un-powered.
- Connect the module to an appropriate speaker unit.
- Connect the source to the input
- Set the source level to a typical audio level.
- Place a jumper between pins 1 and 5 of PL5 to inhibit the DSP action
- Switch on or Power up the module.
- Make sure that the Overload LED is not illuminating on audio peaks. If it is, go through the previous steps with the source level set lower.
- Adjust VR2 (Level) control until the audio sounds about the same level as when the module was switched off or powered down.
- The module is now set up with no appreciable throughput gain.
- Adjust the input source to check that the audio output level changes commensurately and that the Overload LED does not flash.

- This procedure may have to be carried out a few times if the powered-up output level is to track that of the original source level.

For certain situations, the required audio may be required to be much louder when the module is powered and carrying out its DSP function. In this case, carry out the above procedure, but instead of adjusting VR1 to sound the same, you can increase the level. Bear in mind that if the user is un-aware of this fact, they may get a bit of a shock when the module is powered and the volume suddenly changes from a normally acceptable level to one that's extremely loud.

**Other signal considerations**
The NEDSP1962 is meant for operation with medium to high level audio signals such as those used to drive speakers. If operation with lower level signals such as microphones, are required then bhi Ltd should be contacted for further information on how to achieve this.
Due to the adaptive nature of this Noise Reduction algorithm, a small delay may be heard between any input audio changes and the action of the Noise Reduction algorithm, especially when the input signal disappears then re-appears or the input signal become clear of noise and then gets noisier. Under these circumstances the algorithm needs to adapt to the signal and this can take about 50mS to 100mS. For optimum performance the input signal should be applied constantly where possible.
Upon powering up or switching On a very quiet thump of click may be heard in the loudspeaker. This is due to the amplifier being enabled.

## Functions

### Noise Reduction Levels

There are 8 levels of Noise Reduction available. The amounts by which any Noise and Tone signals are reduced are shown in the table below:

| Reduction Level setting | Tone Reduction | White Noise Reduction |
|---|---|---|
| 1 | 4dB | 8dB |
| 2 | 5dB | 12dB |
| 3 | 6dB | 16dB |
| 4 | 8dB | 20dB |
| 5 | 16dB | 25dB |
| 6 | 21dB | 30dB |
| 7 | 25dB | 35dB |
| 8 | 65dB | 40dB |

The DSP Noise Reduction Level is set by the following combination of on-board Jumpers JP3, JP4 and JP5. These can be found on the underside of the module adjacent to PL7 Pads.

| Noise Reduction Level | JP5 | JP4 | JP3 |
|---|---|---|---|
| 1 | Open | Open | Open |
| 2 | Open | Open | Link |
| 3 | Open | Link | Open |
| 4 | Open | Link | Link |
| 5 | Link | Open | Open |
| 6 | Link | Open | Link |
| 7 | Link | Link | Open |
| 8 | Link | Link | Link |

**Remote Setting of DSP filter level**

To remotely set the DSP Level, ensure that any solder jumpers placed on JP3 through to JP5 are removed. The Level may now be set using connections PL7. See the
These connections are buffered on the board by transistors and pulled up to +5 Volts via resistors. Do not apply control voltages greater than 5 Volts to these pins.

| Noise Reduction Level | J18 | JP17 | JP16 |
|---|---|---|---|
| 1 | 5 V | 5V | 5V |
| 2 | 5 V | 5 V | 0 V |
| 3 | 5 V | 0 V | 5 V |
| 4 | 5 V | 0 V | 0 V |
| 5 | 0 V | 5 V | 5V |
| 6 | 0 V | 5 V | 0V |
| 7 | 0 V | 0 V | 5 V |
| 8 | 0 V | 0 V | 0 V |

**Noise Reduction On/Off**

The module has the provision for remotely enabling and disabling the Noise Reduction, while in operation. The default setting for the module is Noise Reduction On. This may be switched by using the NR Inhibit PL7 Pin 1. To Inhibit the Noise Reduction, connect this pin to Ground (PL7- Pin 5), to Enable Noise Reduction leave this connection unconnected.

**Audio Bypass**
The NEDSP1962 features a relay to bypass the audio signal when the Module is switched Off or Power is removed.

## Application Notes

Noise Cancellation On/Off with indication

In the example opposite a Tricolour (or separate Red and Green) LED's are used to give a visual indication of the Noise Reduction mode. The Green LED will illuminate when the Noise Reduction is On and the Red will illuminate when the Noise Reduction is Off.

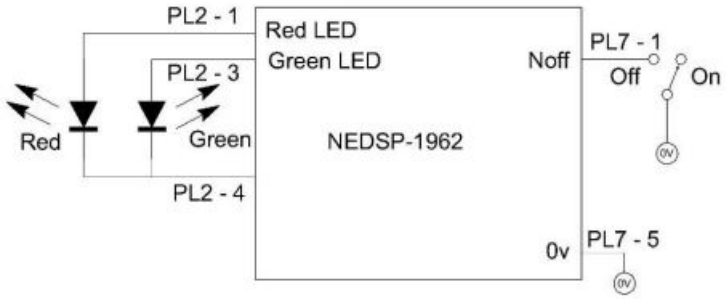



Figure 7. Noise Reduction On/Off with Red/Green LED Status indication
The switch used in the above example could be replaced by a set of relay contacts if it is necessary to provide isolation or remotely control the Noise Reduction On and Off state.

**Remote adjustment of Noise Reduction level**
This section illustrates the various options for altering the DSP level remotely, during operation.

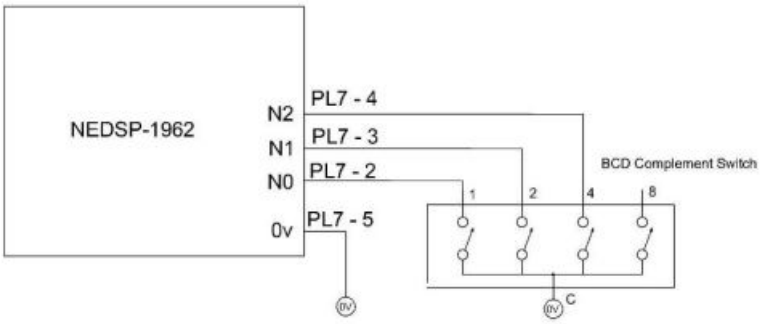



**Figure 8. Basic setting using a BCD switch with complementary logic**

The module can be controlled with a microcontroller. It is not necessary to drive the control pins with the controller as the NEDSP has internal pull-up resistors. Therefore, the microcontroller would operate pulling Low or in a High impedance state.

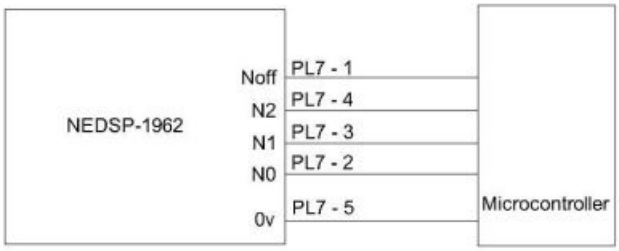
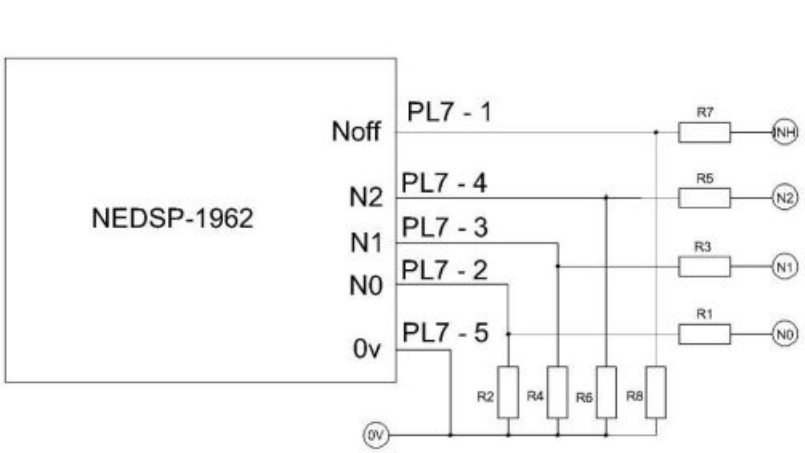



**Figure 9 – Basic Microcontroller interface**

Important Note: If the Microcontroller is driving the control pins both High and Low, it should be operating from a 5 Volt supply only. If this can't be achieved, then consider using either the Transistor method of interfacing as shown in Figure 11 or the much simpler voltage divider method outlines for greater than 5 Volt operation shown in Figure 10.
If the control system is of greater than 5 Volts is to be used to drive the NEDSP1962 control

pins, make sure that the drive voltage is no higher than 3.3 Volts.

A simple resistor attenuator circuit is shown in Figure 10.




pins, make sure that the drive voltage is no higher than 3.3 Volts.

A simple resistor attenuator circuit is shown in Figure 10.

**Figure 10 – Using a Resistor Divider circuit to allow operation with higher voltage logic**

For +5 Volt Logic, the suggested values for R1, R3 and R5 is 1 kOhm, while R2, R4 and R6 should be 1.5 kOhm.

Note: It should be remembered that the NEDSP-1962 provides its own +5 Volt Pull-up voltage, so that the control system only needs to be able to pull the lines Low in order to provide effective control.

The transistors allow interfacing with higher or lower Logic control voltages. For Higher Voltages, as a rough guide the Resistors R1, R3, R5 and R7 can be around 10 kOhm. Resistors R2, R4, R6 and R8 could be in the range 2.2 kOhm for control voltages over 10 Volts and 4.7 kOhm for voltages between 5 Volts and 10 Volts.

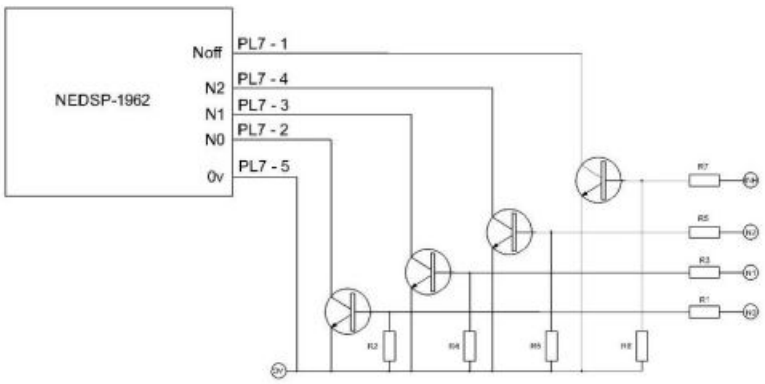



**Figure 11. Control of settings using a Transistors**

If working with low level Logic signals, such as 3.3 Volts or below, the resistor values may be reversed, such that R1, R3, R5 and R7 are 2.2 kOhm and R2, R4, R6 and R8 are 10 kOhm. It should be noted that the control Logic in this case is inverted and where the NEDSP 1962 would require a Logic Low as shown in the Table contained in Section 4.2, it now requires a Logic High.

## Dimensions

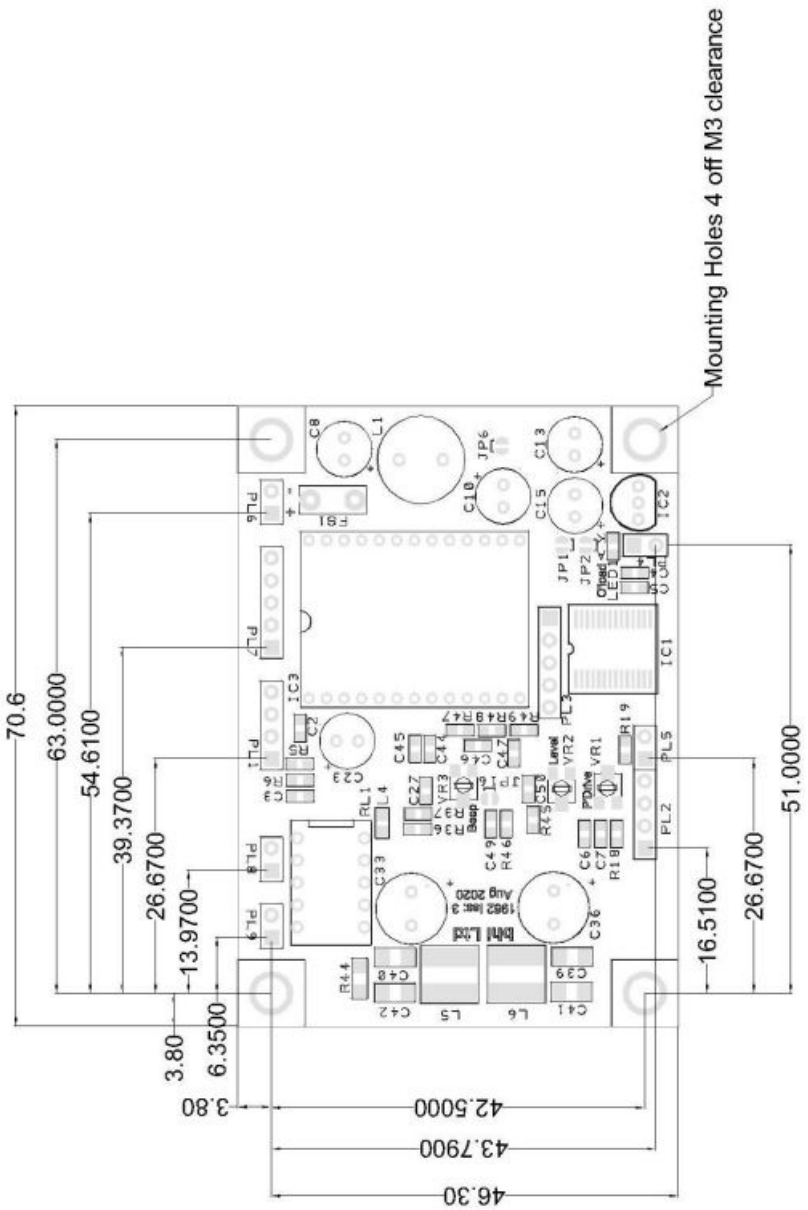
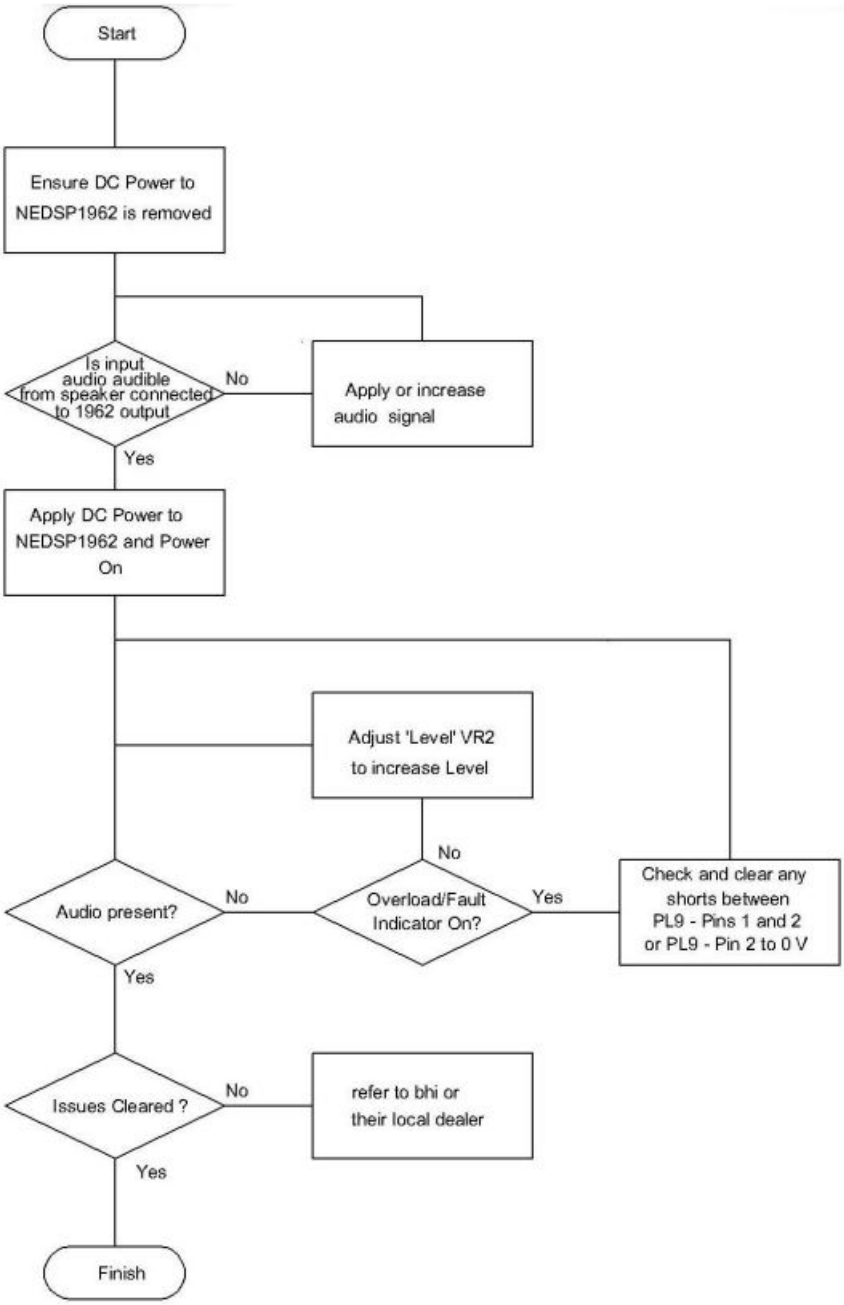



**Figure 12 – Plan view of the PCB Mechanical layout with dimensions.**

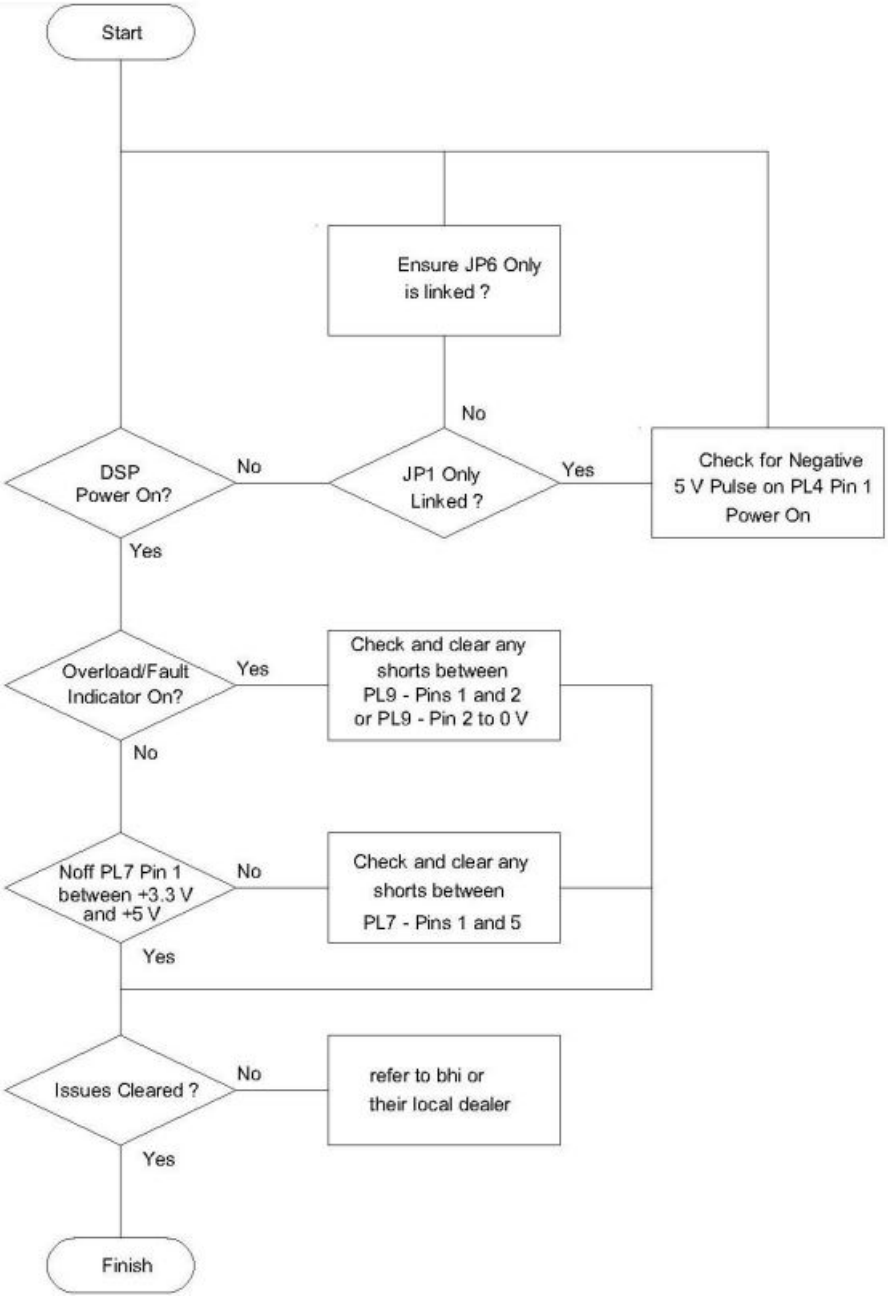
The PCB assembly has a maximum height of 13mm above the PCB and it needs approximately 3 mm clearance underneath. The PCB itself is 1.6 mm thick.

## Troubleshooting

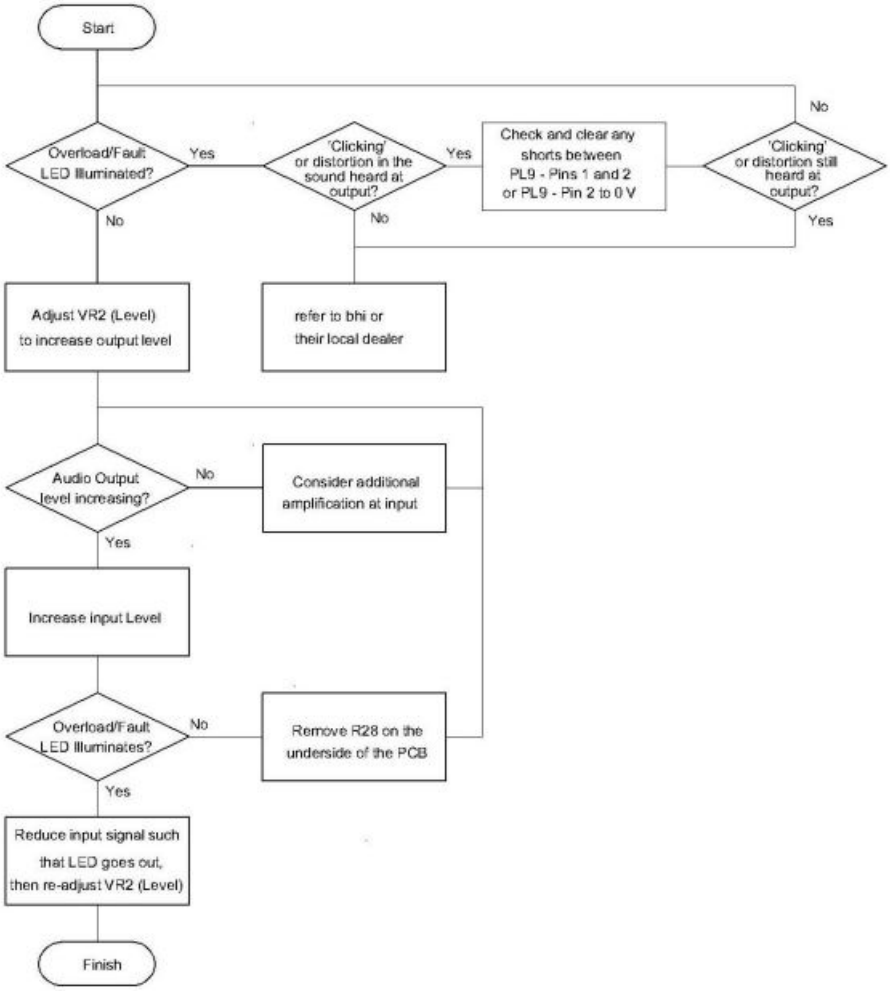
### No Audio Output



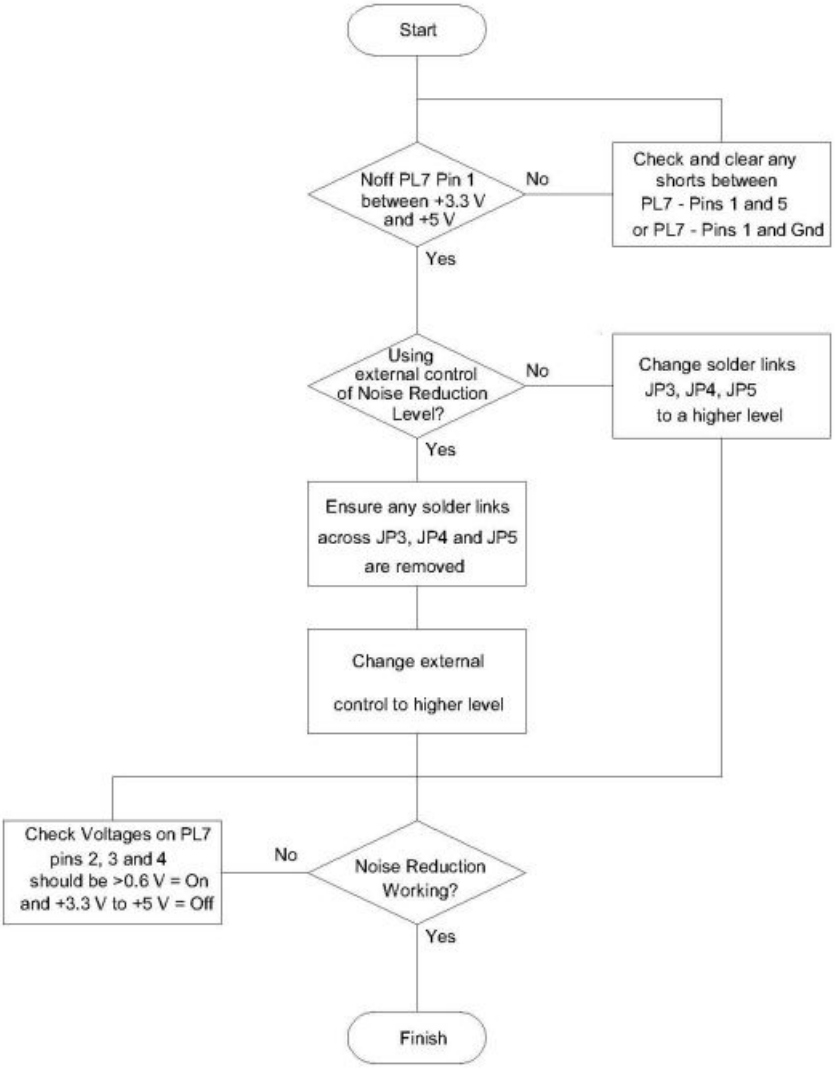

**No Noise Reduction**




**Insufficient Audio Output**




**No Noise Reduction**

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## Documents / Resources

| | |
|---|---|
|  | bhi-ltd NEDSP1962-PCB DSP Noise Cancelling PCB Module [pdf] User Manual NEDSP1962-PCB, NEDSP1962-PCB DSP Noise Cancelling PCB Module, DSP Noise Cancelling PCB Module, Noise Cancelling PCB Module, Cancelling PCB Module, PCB Module, Module |

## References

- SaaS | | ; ,APP ,SCRM , !
- bhi Ltd | Noise Cancelling Products & Technology For Radio